OPERATING INSTRUCTIONS

VICOTEC320
Measurement of
NO, NO_2 , CO and Visibility

Installation
Operation
Maintenance

SICK
Sensor Intelligence.

Document Information

Document ID
Title: Operating Instructions VICOTEC320
Part No.: 8011703
Version: 2-2
Release: 2013-07

Described Product:
Product name: VICOTEC320
Variants: VICOTEC321
VICOTEC322
VICOTEC323
VICOTEC324

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Original Documents
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Glossary

Skilled persons: Persons who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

Competent persons: Persons who, based on their technical training on, and knowledge concerning the specific device, as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

Instructed persons: Persons properly instructed on the tasks assigned, possible risks and necessary protective measures.

Warning Symbols


Hazard (general)


Hazard by voltage


Hazard in potentially explosive atmospheres


Hazard by ultraviolet radiation (UV light)

Signal Words

DANGER
Immediate hazard which *will* result in severe personal injury or death.

WARNING
Risk or hazardous situation which *could* result in severe personal injury or death.

CAUTION
Hazard which *could* result in less severe or minor injuries *and/or* property damage.

Information Symbols


Important technical information for this product


Supplementary information

VICOTEC320

1 For your Safety

Safety information
Responsibility of the operator
Intended use

1.1 Short summary of the most important hazards

Read and always observe the safety and warning information in these Operating Instructions.

WARNING: Danger through defective device

The VICOTEC320 is likely to be unsafe when it:

- Shows visible damage on the outside.
- Has been penetrated by moisture.
- Has been stored or operated under irregular conditions.

When safe operation is no longer possible:

► Put the VICOTEC320 out of operation, separate all connectors from the power supply and secure against unauthorized start-up.

WARNING: Risk of explosions through explosive sample gas

► Do not use the VICOTEC320 to measure explosive, combustible or flammable gases.

WARNING: Hazard in potentially explosive atmospheres

► Do not use the VICOTEC320 in potentially explosive atmospheres.

CAUTION: Eye damage through very bright light

UV radiation (VICOTEC322, -323, -324) and halogen light (VICOTEC321) can cause eye inflammation when eyes are subjected to the radiation for longer than 10 minutes.

► Wear protective goggles (normal glass or plastic is sufficient).

1.2 Basic information

1.2.1 Detail level of these Operating Instructions

These Operating Instructions contain a fundamental description of the VICOTEC320 series measuring system and serve as guide for installation, operation and scheduled maintenance. They also contain information on safe operation of VICOTEC320 series devices.

► Read and observe the corresponding Sections in these Operating Instructions.

1.2.2 Scope of application and identification

These Operating Instructions are applicable for VICOTEC320 series devices

The following variants are available to measure different components:

- VICOTEC 321 to measure visibility and NO_2
- VICOTEC 322 to measure visibility and NO
- VICOTEC 323 to measure visibility, NO and NO_2
- VICOTEC 324 to measure NO and NO_2

The Identification number of the VICOTEC320 (type plate) is located as follows:

Table 1 Type plate locations

Device	Type plate location
Sender/receiver unit	Outside: Next to the connections Inside: At the bottom of the left enclosure side
Reflector	Outside: Next to the connections Inside: At the middle of the right enclosure side
Connection unit	Outside: At the top of the right enclosure side Inside: Next to the connections

1.2.3 Designated users

The VICOTEC320 may only be installed and put into operation by skilled persons who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

The VICOTEC320 may only be maintained by persons properly instructed on the tasks assigned, possible risks and protective measures.

1.2.4 Responsibility of the operator

- Only operate the VICOTEC320 according to the intended use (→ § 1.2.5).
- Follow all specifications in these Operating Instructions and only operate the VICOTEC320 as described in these Operating Instructions.
  Contact your local SICK representative before performing any work described where the information in these Operating Instructions is inadequate or capable of being misunderstood.
- Keep these Operating Instructions for future use.
- Pass these Operating Instructions on to a new owner.
- Pay attention to the prescribed maintenance work.
- Do not change any settings on or in the device and do not modify any components when such changes are not described in these Operating Instructions or in documents referred to in these Operating Instructions.
- In addition to the Operating Instructions, follow local laws, regulations and operating directives applicable at the respective installation location.

1.2.5 Intended use

Devices of the VICOTEC320 series only serve continuous measurement of concentrations of certain gases, visibility (not on all types) and the temperature in the atmosphere in road tunnels.

1.2.6 Warranty limits

The following parts have limited service lives shorter than five years:

- Lamp (one to four years depending on parameter settings, ambient conditions and contamination in the tunnel)
- Drying agent cartridge in the reflector (one to two years)

1.2.7 Further literature

Other Instructions

- SOPAS ET Software Manual
- VICOTEC320 Service Manual

VICOTEC320

2 Product Description

Functional principle
Design

2.1 Functional principle

The VICOTEC320 is a sensor system for continuous measurement of NO, NO_2 and CO (option) concentrations as well as visibility and temperature in road tunnels.

The following functional principles are used:

- NO, NO_2: DOAS (Differential Optical Absorption Spectroscopy)
- CO: Electrochemical cell
- Visibility: Transmission measurement

For the functional principles, please see the relevant literature, e.g. the internet.

2.2 Performance features

- Fast, representative local measurement
- Very low detection limits for NO and NO_2
- Automatic function monitoring and self-adjustment
- Independent maintenance prompt when contaminated
- Very sturdy design: IP 69K, stainless steel 1.4571
- Compatible to assembly consoles and measuring path lengths of the VICOTEC 410/400 from SICK

2.3 Special features

- Operating hour meter for UV lamp and Logbook function
- High-precision adjustment through automatic mirror tracking
- Temperature recording
- Reflector, heated
- Communication via CAN System bus or Ethernet (optional)

2.4 Device variants

The device variants differ in

- measurable components,
- measuring path,
- connection unit interfaces.

The following variants are available to measure different components:

- VICOTEC 321 (halogen lamp) to measure visibility and NO_2
- VICOTEC 322 (UV lamp) to measure visibility and NO
- VICOTEC 323 (UV lamp) to measure visibility, NO and NO_2
- VICOTEC 324 (UV lamp) to measure NO and NO_2

The sender/receiver unit and the reflector are available for the following measuring distances:

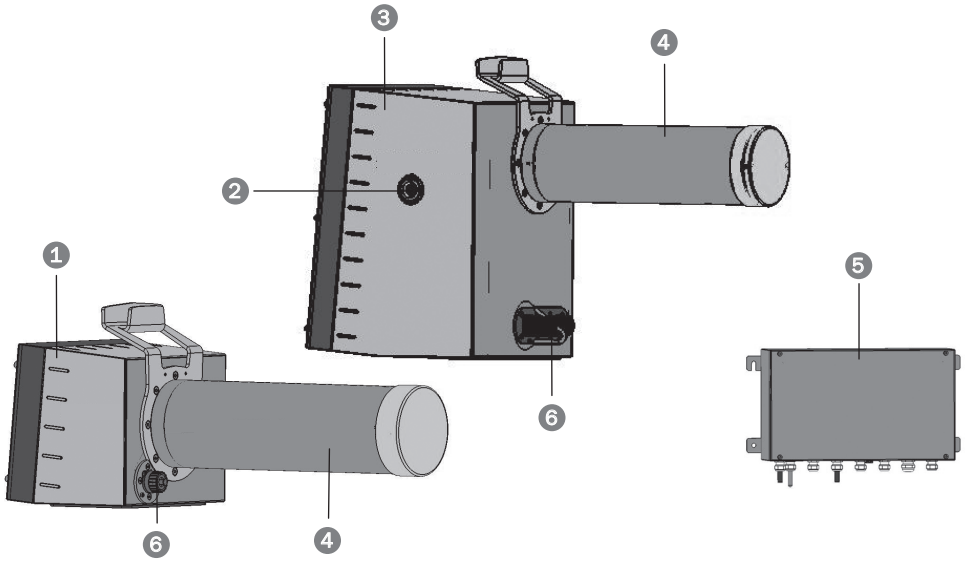
- 10 m
- 20 m

The connection unit is available with the following interfaces:

- Analog/digital
- Ethernet
- The connection unit can contain an optional CO sensor (electrochemical cell)

2.5 Device components/layout

Fig. 1 VICOTEC320 layout



1	Reflector
2	LED matrix to signal automatic beam tracking
3	Sender/receiver unit
4	Dust protection tube
5	Connection unit
6	Plug connections

VICOTEC320

3 Project Planning

3.1 Assembly project planning

3.1.1 Arrangement along the tunnel section

The number and distribution of measuring points depends on the ventilation system used. Single factors are:

- Type of tunnel profile
- Section route
- Ventilation system design
- Number and arrangement of fans
- Regional regulations

Measuring point selection depends primarily on the following criteria:

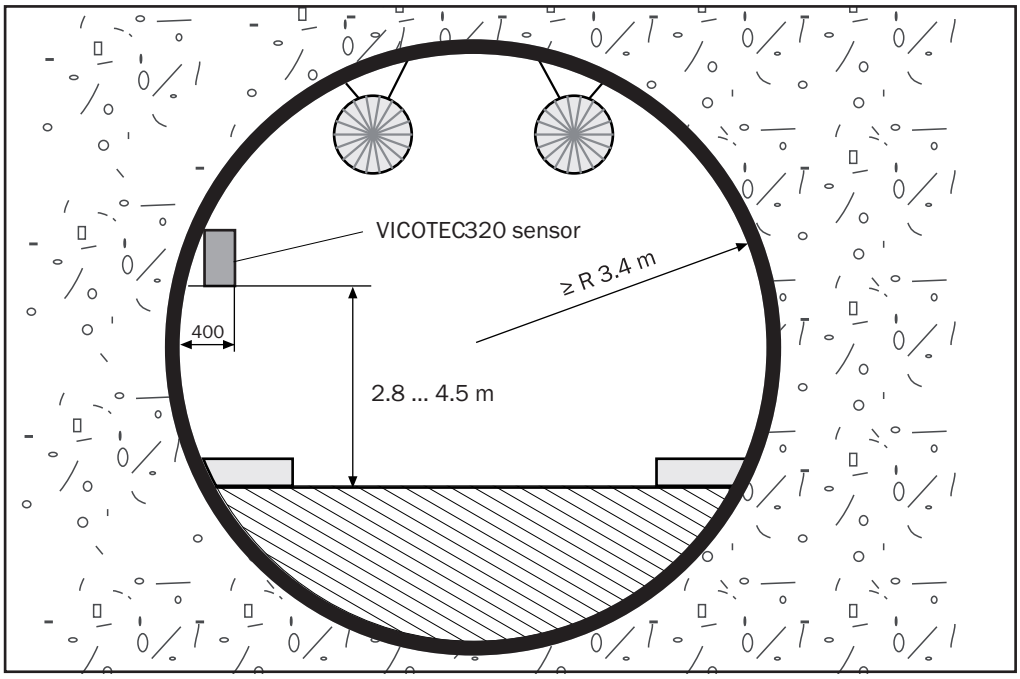
- A combination of VICOTEC320 with VICOTEC 411 (visibility) or VICOTEC 414 (CO and visibility) is recommended for optimum measurement results. In this case, position the VICOTEC 411/414 units closer to each other and the VICOTEC320 units further apart.
- The recommended distance between visibility measurements depends on whether these are also to be used for smoke detection:
  - Without smoke detection: ≤ 400 m
  - With smoke detection: ≤ 150 m
- An even spread along the tunnel length is recommended for semi and transverse ventilation, with at least 2 measuring points per ventilation section.
- NO/NO_2 can be measured every 400 – 1000 m. Position the measuring points preferably at the tunnel exit in tunnels with one-way traffic.
- Two-way traffic can still arise in tunnels with one-way traffic. It is therefore recommended to install at least 3 measuring points for visibility in tunnels with lengthwise ventilation: one each about 150 m from the entrance and at least one in the middle of the tunnel.
- It is recommended to install additional fog sensors (e.g. VISIC620) near the tunnel portals when there is a risk that fog can be sucked into the tunnel. Dust particles acting as additional condensation crystals can strengthen the fog effect in the tunnel sections. Fog moisture overlays visibility due to dust particles. Fog sensors serve to prevent fog drifts being sucked into the tunnel. Alternately, visibility can be measured at the tunnel portals using extractive measuring devices (e.g. VICOTEC450) that heat the air sucked in and therefore evaporate fog moisture.
- When the tunnel roadway curves, ensure that the measuring beam between single sensors is not interrupted by the tunnel wall, fixtures or vehicles passing each other (see → p. 18, § 3.1.3).

3.1.2 Arrangement in cross-section profile

Particle concentration distribution in a tunnel is generally very even across the profile cross-section during traffic movement. Traffic flows and lengthwise flows through natural ventilation and the piston effect of vehicle movement in separate tunnel sections for each direction effect rapid swirling of the air in the tunnel. The turbulence behind vehicles strengthens this effect.

The height is not critical due to excellent swirling. A fitting height between 2.8 and 4.5 meters is aimed at. The sensors contaminate faster when fitted lower and the maintenance effort increases when the sensors are fitted higher.

Fig. 2 VICOTEC320 fitting height



Fitting location selection of the respective sensor pairs depends primarily on the following criteria:

- Mount the sensors at a safe distance from traffic movement (see for example Section 2 of the German “Richtlinie für die Ausstattung und den Betrieb von Straßentunneln RABT”, version 2006 (Regulations governing equipping and operating road tunnels)).
- Good access for maintenance and checking work must be ensured. Locate the sensors in a protected recess when possible.
- Do not locate sensors in close vicinity to ventilators or in the fresh air flow from blowout units so that the measured value records the effective concentration ratios.
- The measuring beam must run lengthwise between sensors and must not be hindered by fixtures or vehicles passing each other. Fixtures that shine (e.g. emergency exit signs) should be at least 1 m from the optical axis.
- No reflecting paint should be on the wall between sensors.
- Maintain a distance of 10 to 20 m between both sensors depending on the VICOTEC320 variant used.
- Plan sufficient clearance to be able to flap or remove the enclosure cover.

Measured values are kept constant at first when the light beams are interrupted. A malfunction message is sent to the evaluation unit when interruptions last longer than two minutes.

Fitting options:

- Both sensors on a wall in a recess (recommended).
- Both sensors on a wall above the side strip; requires safety measures for maintenance work in cramped conditions.

3.1.3 Arrangement with special prerequisites

Tunnel curvature

The sensors can be used with tunnel curvatures up to the following curve radiuses:

Measuring section (A)	10 m	20 m
Inner radius (R_1)	Min. 58 m	Min. 115 m
Outer radius (R_2)	Min. 147 m	Min. 438 m

Fig. 3 Fitting sensors on the inner curve wall

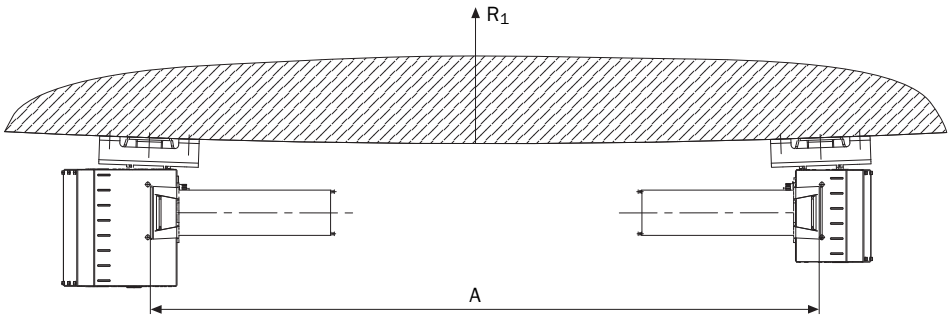
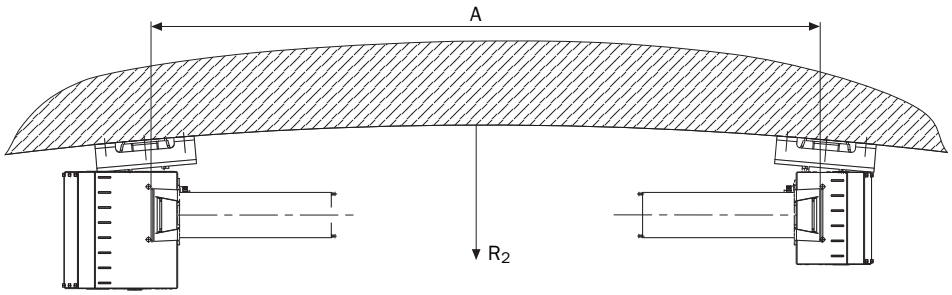


Fig. 4 Fitting sensors on the outer curve wall

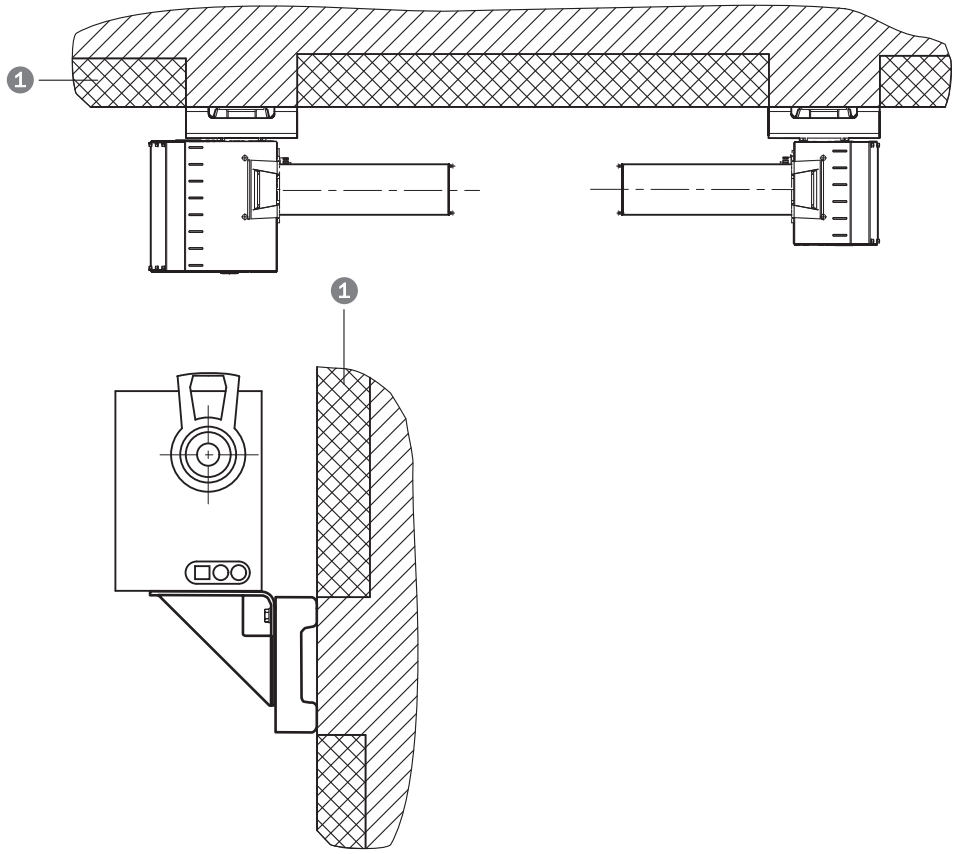


Tunnel with sound insulation wall

Provide appropriate assembly bases onsite when fitting sensors on a tunnel wall with sound insulation.

The assembly bases must provide a firm base suitable for reliable sensor fitting.

Fig. 5 Fitting sensors with sound insulation



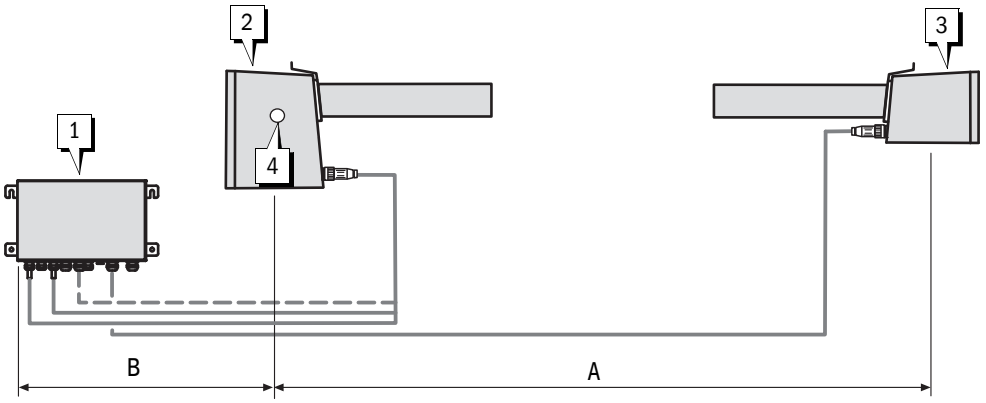
1	Sound insulation

3.2 Electrical installation project planning

Observe the relevant safety regulations during all installation work. Take suitable protective measures against all possible local risks or those arising in connection with the system. See also → „For your Safety“ (page 7)

- Sender/receiver unit (2) must always be fitted on the left (see → Fig. 6), so that visor (4) is accessible.
- Position connection unit (1) so that it can be connected to the sender/receiver unit with a 1 m long cable.
- It must be possible to separate every device singly from the power supply system, e.g. using a switch or circuit breaker.

Fig. 6 Sensor arrangement



1	Connection unit
2	Sender/receiver unit
3	Reflector
4	Visor
A	Measuring section (10 or 20 m)
B	Max. 0.7 m (Cable length max. 1 m)

VICOTEC320

4 Installation

Transport
Assembly
Installation

4.1 Transport

Only use the packing provided by SICK to transport sensors. Warranty claims are void when this is not observed.
The packing can be obtained from SICK free of charge when required.

4.2 Scope of delivery

The scope of delivery includes:

- Sender/receiver unit (incl. screws for fastening on assembly console)
- Reflector (incl. screws for fastening on assembly console)
- Connection unit (incl. dowels and screws for wall fitting)
- Connection lines from the connection unit to the sender/receiver unit and to the reflector

Not included in the scope of delivery:

- Stainless steel assembly consoles for the sensors

4.3 Material required

Tools required

Apart from standard tools (such as drill, water level, tape measure), you also need the following tools for the installation:

- Drill tips 8 and 15 mm
- Blowout pump for dowel holes
- 18 and 19 mm socket wrench
- Rubber or plastic hammer
- Two laser adjustment units (obtainable from SICK; see → p. 61, § 9.3.3)

Additional material required

- 2 stainless steel assembly consoles incl. fixing accessories
- Connection lines acc. to → Table 2 (page 26)

4.4 Assembly preparation

► Secure the place of work
► Provide adequate lighting and power
► Provide a jack lift or stable ladder with clearance to wall

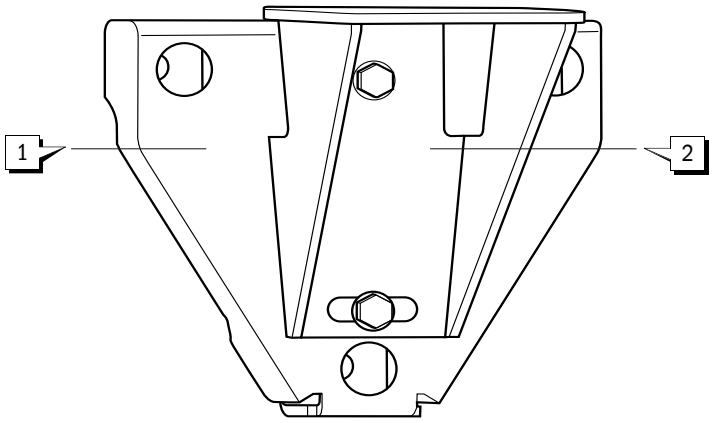
4.5 Assembly

Assembly work must only be carried out by skilled persons familiar with the assembly work.

4.5.1 Fitting the assembly consoles

The assembly consoles comprise 2 parts:

Fig. 7 Assembly console



1	Wall holder for wall fitting
2	Angle bracket to fasten the sensor

Two screws fasten the wall holder and the assembly console together. The angle bracket can be swiveled up to ±7.5° to compensate any assembly unevenness.

Observe the following points during assembly:

- ► Keep the length of the measuring section as exact as possible. Record small deviations in the Assembly protocol.
- ► Mount both assembly consoles at the same height. Height differences in the optical axis can be compensated later by swiveling the angle bracket.
- ► Only use high-strength and absolutely non-corrosive fastening material made of stainless steel because the tunnel atmosphere is highly corrosive.
- ► Align both assembly consoles at the same tilt angle to the tunnel wall. Different tilt positions to the tunnel perpendicular make the following sensor alignment difficult. Insert washers under the wall holder when necessary.
- ► Ensure there is enough space to remove the tube and device cover.
- ► Observe local valid safety measures.

Procedure

1 Determine the installation location for the assembly consoles according to the project planning.

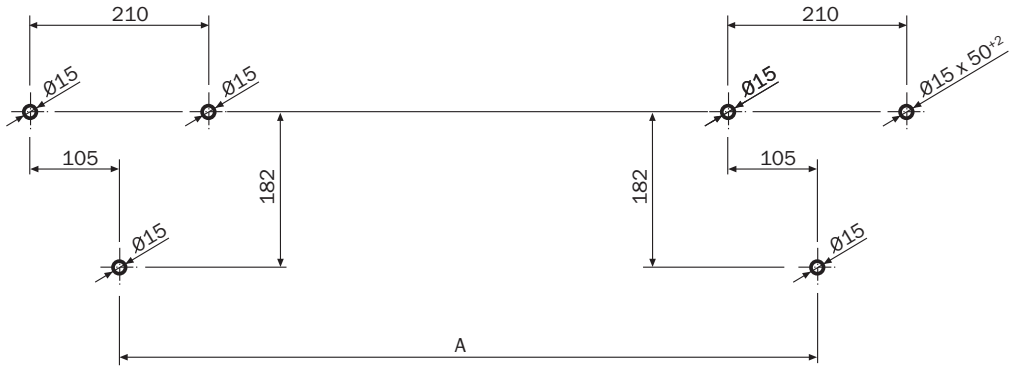
2 Drill the wall holder openings according to the Drilling plan, see figure 8.

3 Insert dowels or wall ties according to the manufacturer's assembly specifications (walls must be made of at least B25 concrete).

4 Screw the wall holder on and tighten the screws with 70 Nm according to the manufacturer's assembly specifications, use a torque wrench as necessary.

5 Screw the consoles on provisionally at first.

Fig. 8 Wall holder assembly drilling plan



Tolerances for measuring path A
10 ±0.1 m
20 ±0.2 m

4.5.2 Fitting the VICOTEC320 sensors

1 Position the sender/receiver unit on the **left** assembly console and screw it on lightly with both the retaining screws included in the delivery.

2 Position the reflector on the **right** assembly console and screw it on lightly with both the retaining screws included in the delivery.

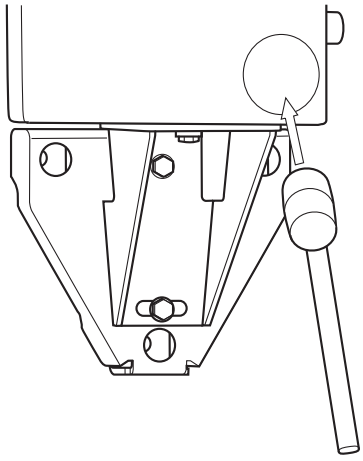
3 Screw a laser adjustment unit on each sensor above the tube using both knurled-head screws.

WARNING: Laser class 2
- ► Do not point the laser beam at persons.
- ► Do not look directly into the laser beam.

4 Switch the laser adjustment unit on one sensor on.

5 Align the sensor horizontally so that the laser beam strikes the vertical line of the cross-hair of the other laser adjustment unit. To do this, tap very lightly against the front lower edge of the sensor enclosure with a rubber hammer (see →Fig. 9).

Fig. 9 Horizontal sensor alignment

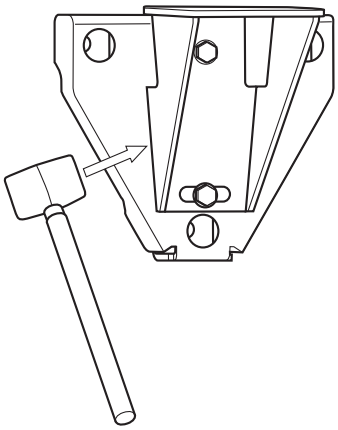


6 Tighten both screws of the sensor with 45 Nm, use a torque wrench as necessary.

7 Loosen the two screws of the angle bracket slightly

8 Align the sensor vertically so that the laser beam strikes the horizontal line of the crosshair of the other laser adjustment unit. To do this, tap very lightly against the front lower edge of the angle bracket with a rubber hammer (see → Fig. 10).

Fig. 10 Vertical sensor alignment



9 Tighten both screws of the angle bracket, use a torque wrench as necessary.

10 Check again whether the laser beam strikes the crosshair and correct as necessary.

11 Switch the laser adjustment unit off.

12 Repeat steps 5 to 11 on the opposite sensor and laser adjustment unit.

4.5.3 Fitting the connection unit

Position the connection unit so that it can be connected to the sender/receiver unit with the 1 m long cables.

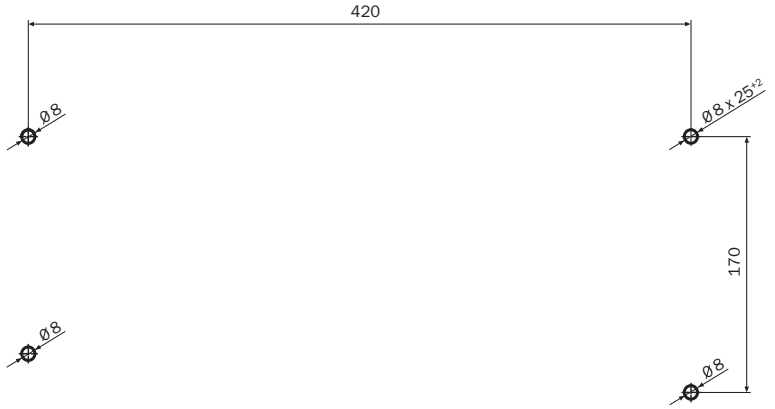
1 Determine the installation location for the connection unit according to the project planning.

2 Drill the openings according to the Drilling plan, see figure 11.

3 Insert dowels or wall ties according to the manufacturer's assembly specifications (walls must be made of at least B25 concrete).

4 Screw the connection unit on.

Fig. 11 Connection unit assembly drilling plan



4.6 Electrical installation

WARNING: Danger though electrical voltage.

- ► Only allow an authorized electrician to work on the electric system.
- ► Observe the relevant safety regulations during all installation work.
- ► Take suitable protective measures against local risks and those arising from the system.

4.6.1 Connecting the sensors to the connection unit

1 Plug the connection lines mounted fixed on the connection unit in the corresponding sockets of the sender/receiver unit.

2 Connect the connection line to the reflector unit (12 m/22 m) included in the delivery to the connection unit and plug in to the reflector.

3 Fasten the connection lines to the tunnel wall.

4 Fit the power separation options provided for each device in the project planning.

4.6.2 Connection unit cabling

Connection lines

The following connection lines can be used:

Table 2 Connection lines

For	Line/type	Max. length	Cross-section
VICOTEC322, -323, -324: Energy supply: 115/230 V AC; 50/60 Hz		Dependent on cable resistance	3 x 1.5 mm²
VICOTEC321: Energy supply: 100 - 240 V AC; 50/60 Hz			
Digital input	A2Y(L)2Y	Dependent on cable resistance	2 x 2 x 0.75 mm²
Relay outputs	A2Y(L)2Y	Dependent on cable resistance	4 x 2 x 0.75 mm²
Ethernet	– Category 5 copper line according to ANSI/ TIA -568 – Fiber optic cable	– 100 m – Up to about 5 km according to type	
CAN bus	Li12YC11(TP) [1]		
Analog outputs: 0 ... 20 mA	Screened and twisted in pairs	Dependent on cable resistance	4 x 2 x 0.75 mm²

[1]Unitronic LiHCH(TP) or equivalent cables can also be used

Warranty claims are void when you use cables not released by SICK for use with the VICOTEC320 (→Table 2).

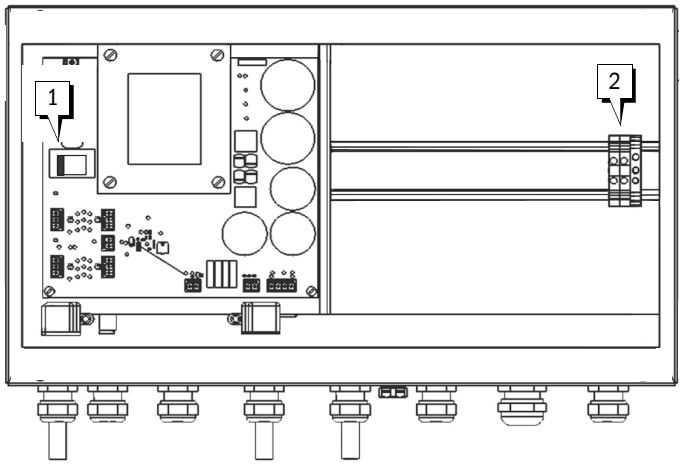
Cabling of voltage supply

► For VICOTEC322, -323, -324:

Set the mains voltage for the connection unit to 115 V or 230 V before connecting the unit to the power supply system.

Use slide switch (1) in the connection unit to the correct voltage.

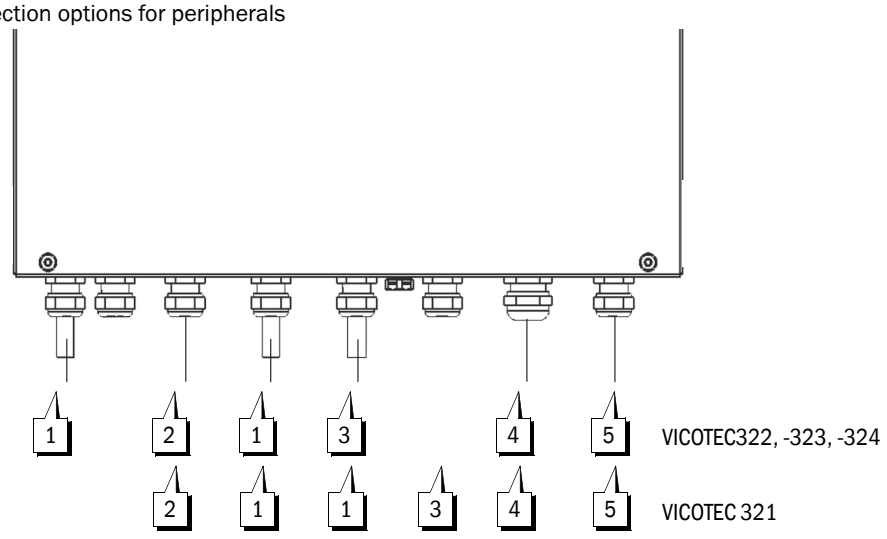
Fig. 12 Slide switch and voltage supply (shown on VICOTEC322, -323, -324)



1	Slide switch for voltage selection (only for VICOTEC322, -323, -324)
2	Terminals for voltage supply (position also for VICOTEC321)

► Connect voltage supply according to terminal designation (L1/N/PE).

Fig. 13 Connection options for peripherals



1	Sender/receiver unit connection (2x)
2	Reflector connection
3	Ethernet (when used)
4	Analog signals (when used)
5	Voltage supply

Input/output cabling for analog/digital variants

The CAN bus terminator must be set to “ON” (LED must be on; see → page 32, Fig. 17)

The inputs and outputs of the connection unit are assigned as follows:

Table 3 Inputs/outputs assignment

Input or output	Assignment
Analog	
Output 1	Visibility
Output 2	Temperature
Output 3	NO
Output 4	NO_2
Output 5	CO
Digital	
Relay 1	Operation/fault for NO, NO_2, visibility ● Operation: Relay is closed ● Fault: Relay is open
Relay 2	Maintenance request signal ● No maintenance request: Relay is open ● Maintenance request (e.g.: contamination): Relay is closed
Relay 3	Measuring operation signal ● Measuring operation: Relay is open ● Not in measuring operation (e.g. during maintenance, adjustment etc.): Relay is closed
Relay 4	Operation/fault for CO (option) ● Operation: Relay is open ● Fault: Relay is closed
Input 1	Maintenance mode (measured values frozen)

Fig. 14 I/O modules and circuit diagram of analog modules without CO inlets/outlets

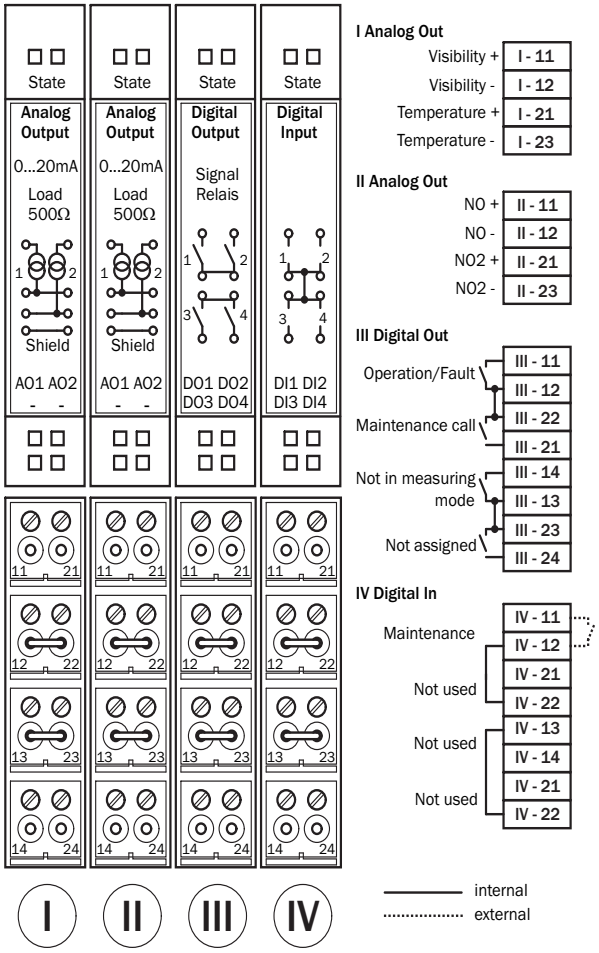


Fig. 15 I/O modules and circuit diagram of analog modules with CO inlets/outlets

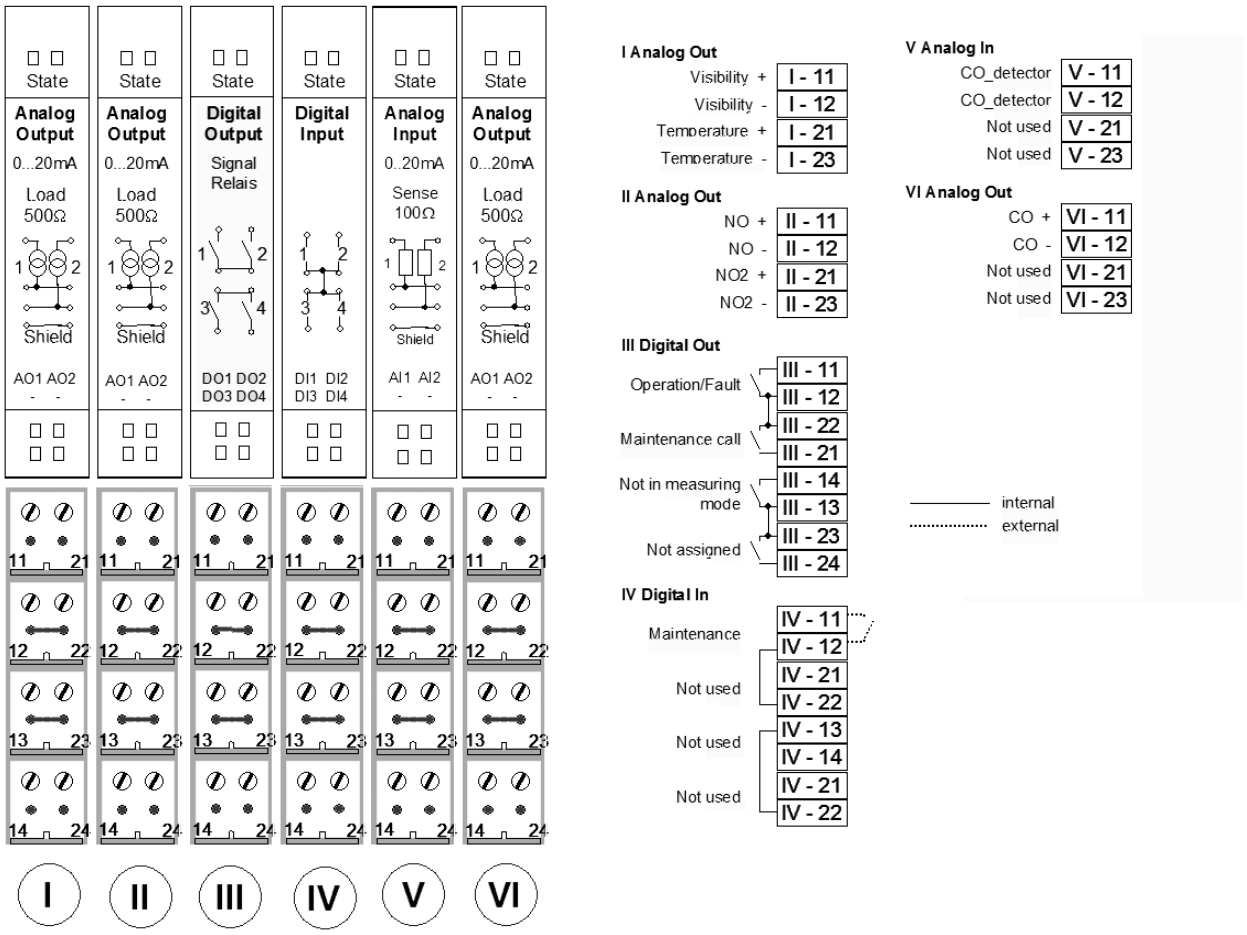


Table 4 Significance of LEDs

Module	LED	Significance
Digital out	Green	Active
Digital in	Green	Contact closed
Analog out	Green	Actual current value = rated current value
Analog in	Green Off	0 mA ≤ I_{on} < 22 mA I_{on} ≥ 22 mA

Cabling of reflector heating

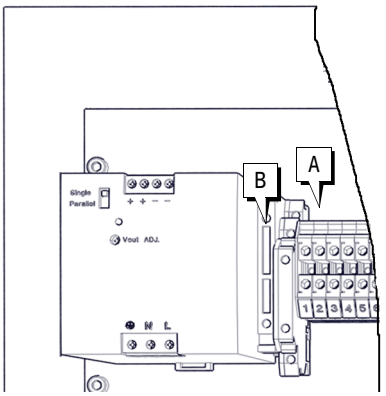
► For VICOTEC322, -323, -324:

Connect the blue and brown lead of the line between reflector heating and connection unit to the “reflector heating” terminals (→ page 32, Fig. 17).

► For VICOTEC321:

Connect the blue and brown lead of the line between reflector heating and connection unit to terminals 1 and 2 (A) of the terminal strip.

Fig. 16 Reflector heating connection on VICOTEC321



A	Terminals 1 and 2
B	Fuse 2 A, slow Reflector heating

Checking cabling

Correct cabling can be checked as follows:

- The gateway LEDs are green (State, CAN, I/O).
- The error LED on the gateway is off.
- The 120 V LED (only on VICOTEC322, -323, -324) and the 24 V LED are green.
- The status LEDs of the I/O module blink green.
- The reflector heating LED is green (only on VICOTEC322, -323, -324).
- The alignment LEDs on the sender/receiver unit flash sequentially.

Fig. 17 VICOTEC322, -323, -324: Positions of LEDs in the connection unit for analog/digital variant

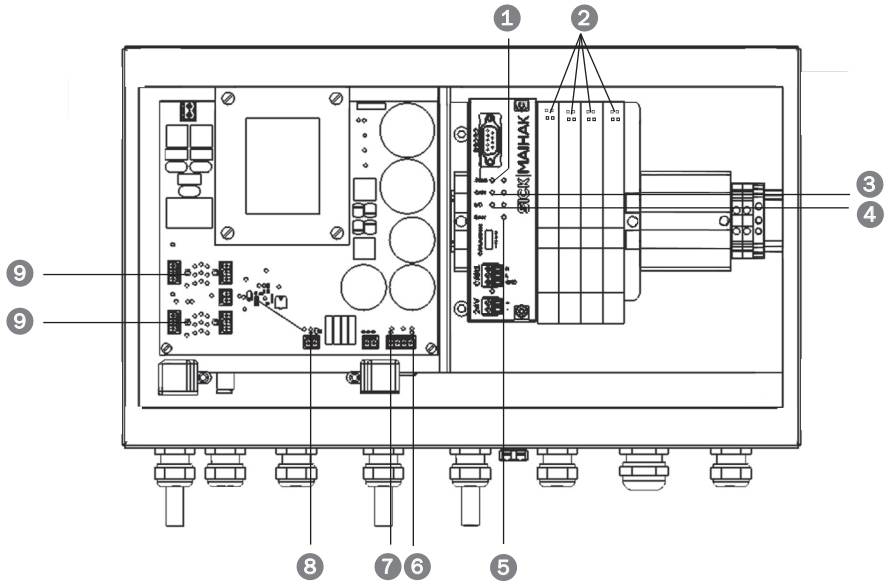
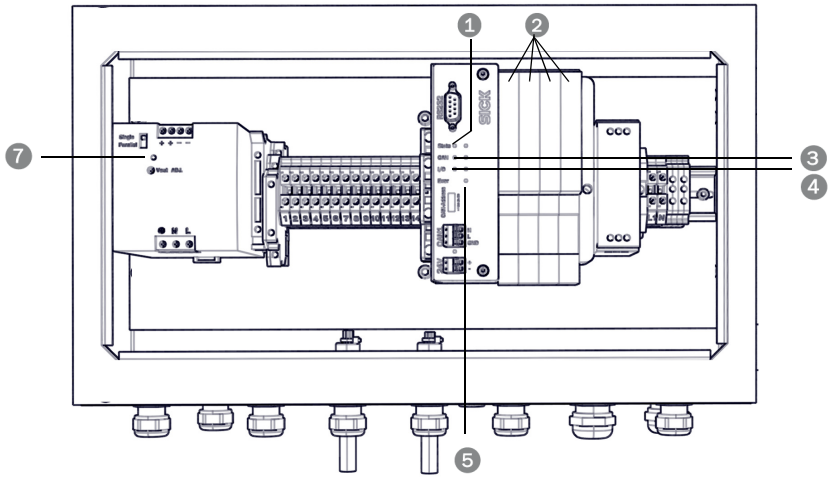


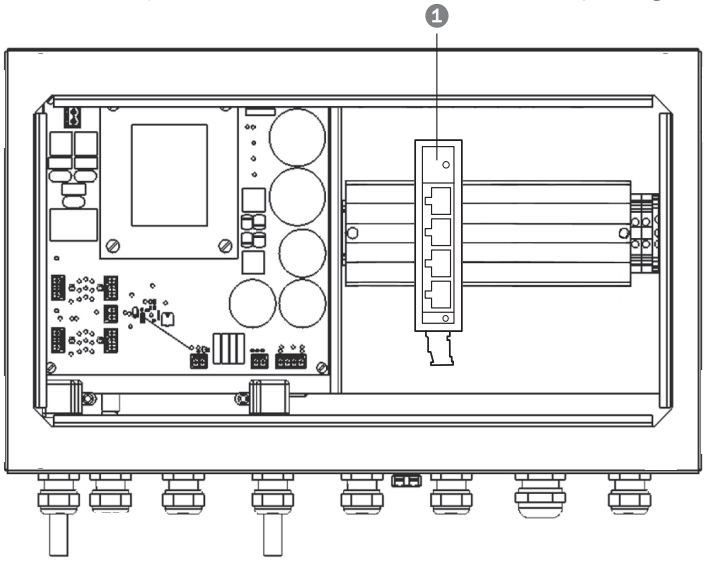
Fig. 18 VICOTEC321: Positions of the LEDs in the connection unit for analog/digital variant



1	Gateway state	Green LED blinks in operation Red LED on: CAN bus is connected but not initialized
2	I/O module state	LED1 blinks in I²C bus cycle pulse LED2 blinks in data transfer cycle pulse
3	Gateway CAN	LEDs blink: Data transfer via CAN bus LEDs on: No CAN bus connected
4	Gateway I/O	LED1 blinks in I²C bus cycle pulse LED2 blinks in data transfer cycle pulse
5	Gateway error	LED on: No I/O module found on gateway or one or more modules failed during operation
6	120 V	
7	24 V	
8	Reflector heating 24 V	
9	CAN bus connection	LED is green: CAN bus terminator is activated.

Connecting the Ethernet cable for Ethernet variant

Fig. 19 Ethernet connection (shown for VICOTEC322, -323, -324. Corresponding for VICOTEC321)



- ► Lead the Ethernet cable through the nearest cable gland (→ page 27, Fig. 13) and plug into switch (1).
- ► Cabling of reflector heating: → page 31

VICOTEC320

5 Start-up and Operation

5.1 Start-up

The start-up must only be performed by authorized technicians and is described in the Service Manual.

> Wait two hours after start-up until the system has heated up. It has then reached a thermal balance and delivers measured values within the tolerance band.

5.2 Operation

5.2.1 Tunnel cleaning

> Cover every sensor tube with a protective cap during tunnel cleaning.

VICOTEC320

6 Using the SOPAS ET Software

6.1 Operating the VICOTEC320

The VICOTEC320 runs automatically after start-up and does not require further operator intervention. You can however use the SOPAS ET software to change the configuration or display measured values.

6.2 SOPAS ET software

The SOPAS ET software serves to set the VICOTEC320 parameters. The parameter records can be stored as a Project file as well as archived on the PC. Measured values can also be read out.

6.2.1 SOPAS ET software functions for VICOTEC320 (Overview)

The Online Help of the SOPAS ET software (Help menu) describes the general function of the software and how to use it.

- Menu language selection (German, English)
- Setting up communication with the VICOTEC320
- Password protected configuration for different operator levels
- Output current measured values
- System diagnostics

6.2.2 Installing the SOPAS ET software

Refer also to the booklet in the CD-ROM sleeve for installation information.

1 Start the PC and insert the Installation CD.

2 Call setup.exe directly from the CD when installation does not start automatically.

3 Follow the operating instructions to complete installation.

6.2.3 Basic setting for the SOPAS ET software

Table 5 Basic setting for the SOPAS ET software (extract)

Parameter	Value
Operating interface language	English[1]
Unit of measure for lengths	Metric
User groups (operating level)	Operator
Download parameters when modified	Immediate, fail-safe in the VICOTEC320 EEPROM
Upload parameters after switching on-line	Automatic
Screen split	3 (project tree, help, workarea)

[1]The software must be restarted after changes

6.3 Using SOPAS ET

6.3.1 Creating a connection

Connect data interfaces

► Connect PC (Ethernet interface) and VICOTEC320 via crossover Ethernet line.

Start the SOPAS ET software and call the Scan Wizard

1 Ensure the supply voltage of the VICOTEC320 is switched on.
2 Switch the PC on and start the SOPAS ET software.
SOPAS ET opens the Program window with the English user interface as standard.
3 To change the language setting, click on CANCEL and use the TOOLS/OPTIONS menu to switch the program interface language to GERMAN/DEUTSCH.
4 Terminate and restart SOPAS ET after changing the language setting.
5 Select the CREATE A NEW PROJECT option in the dialog window and confirm with OK.
6 Click on CONFIGURATION in the main window under SCAN WIZARD.
The SCAN WIZARD dialog window appears.

Configure the Ethernet connection

1 Select the ENABLE IP COMMUNICATION checkbox under INTERNET PROTOCOL/INTERNET PROTOCOL (IP) in the SCAN WIZARD dialog window.
2 Select the ENABLE AUTOIP checkbox.
3 Click on EXTENDED....
4 Select COLA DIALECT “Binary” and TCP PORT “2112” and confirm with OK.
5 Click on AUTO IP CONFIGURATION....
6 Click on SEARCH in the AUTO IP CONFIGURATION dialog window.
All connected sensors are shown.
7 To change the IP address, subnet mask or gateway of a particular sensor, mark the sensor and click on EDIT.

> The sensor IP address must not be changed when the VICOTEC320 is integrated in a network or connected to a customer WLAN module. The IP address of the PC can be adapted to the sensor address in order to create a connection. The procedure depends on the operating system on the PC and is described in the Help function on the PC.

8 Close the AUTO IP CONFIGURATION dialog window.
9 Click on INSERT in the SCAN WIZARD dialog window.
10 Enter the sensor IP address and confirm with OK.
A new entry appears in the IP ADDRESS CONFIGURATION list.
11 Confirm settings with OK.

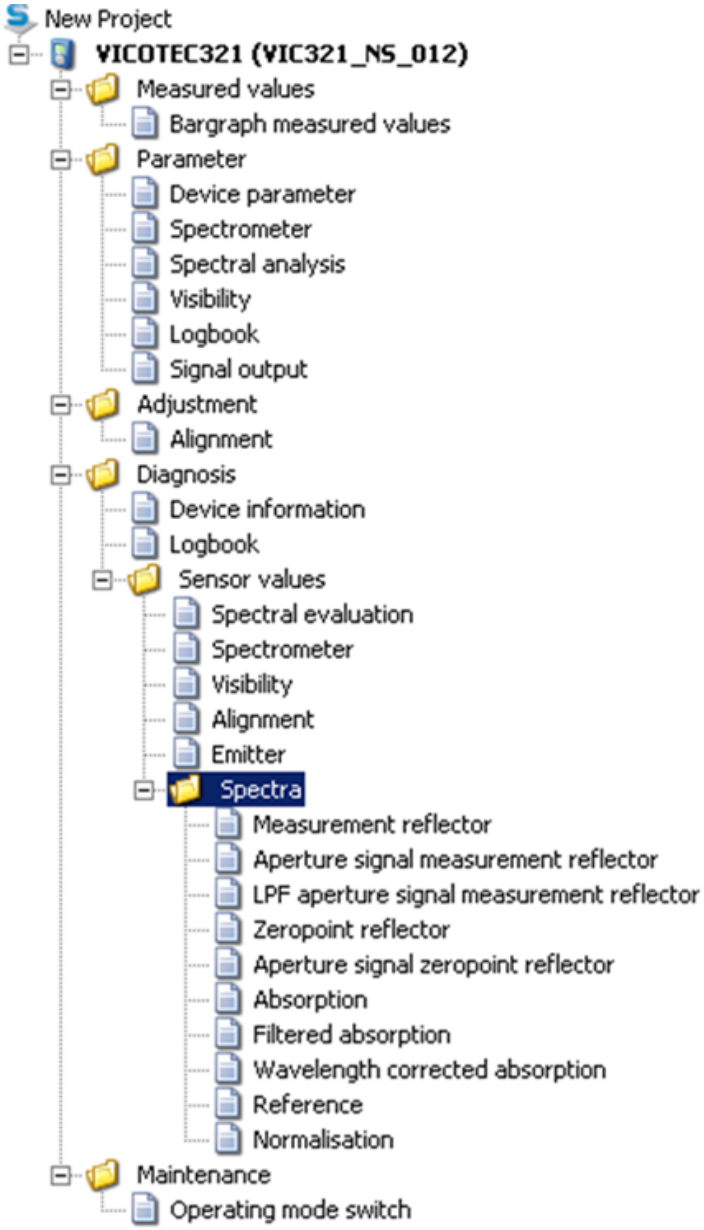
Perform a scan

1 Click on SCAN in the SCAN WIZARD register tab.
The scan progress is displayed in a new window.

2 Close the PROGRESS dialog window with OK after the message SCAN COMPLETE is displayed.
The devices found are listed in the SCAN WIZARD register tab.

3 Drag the desired device into the project tree with the left mouse button held down.
The stored parameters for the selected device are read out.

Fig. 20 VICOTEC320 menu tree



6.3.2 Reading out the VICOTEC320 and operating manually

The corresponding operator level must first be selected to configure a device with the SOPAS ET software. The SOPAS ET software runs in the operator level OPERATOR after start-up and parameters can only be read.

1 Select the LOGIN ON DEVICE command in the TOOLS menu.

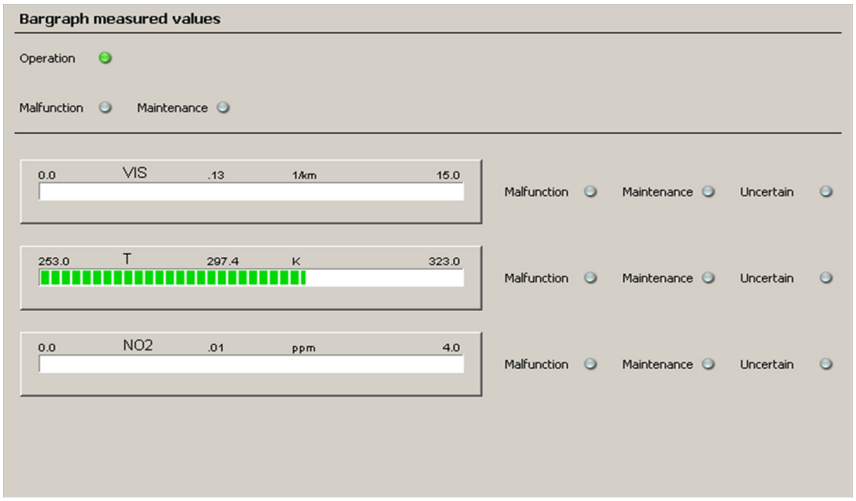
2 Select MAINTENANCE under USERLEVEL in the dialog window and click on LOGIN.

3 Double-click a register tab in the project tree to start it.

4 To save all the data, select the EXPORT DEVICE command in the PROJECT menu.

The following tabs are important for you; the other tabs are shown colored gray and are only relevant for Service technicians.

Bargraph measured values



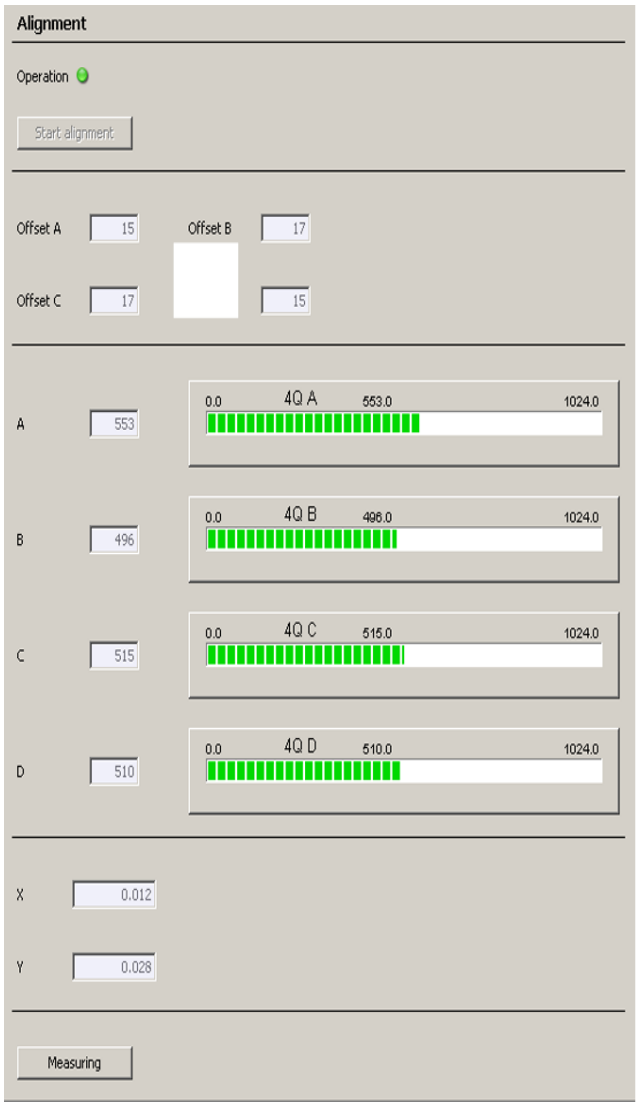
This screen shows whether the sensors are in measuring operation or whether a fault or maintenance requirement exist.

Apart from that, the current measured values for visibility, temperature, NO and NO_2 are displayed (depending on the device variant).

When fault or maintenance request is shown, the measurement triggering the fault or maintenance request is shown next to the measured values.

The UNSAFE LED next to the measured values signals that the measured value is “unsafe” (e.g.: Calibration range exceeded. → Logbook).

Alignment



The beam is tracked automatically to the center of the reflector.

Manual alignment is only possible for authorized users:

1 Click on START ALIGNMENT.
   Measuring operation is interrupted during alignment.
2 Click on MEASURING after alignment has completed.

Device information

This screen shows the serial number, device process and operating hours of the lamp.

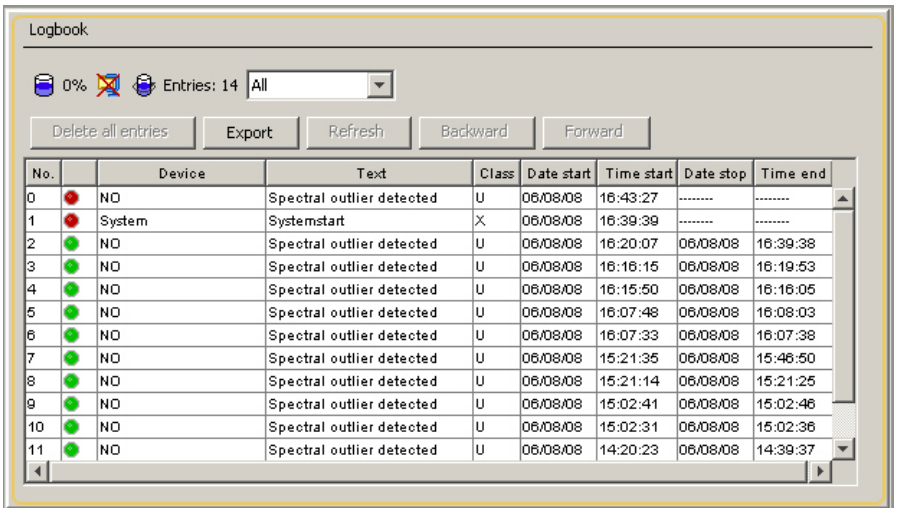
Logbook

All sensor messages are stored in the Logbook. Messages marked with a red dot are still active, messages with a green dot are already completed.

Messages can be filtered according to type:

► Click on the dropdown box and select the type of message required.

Fig. 21 Logbook



No.		Device	Text	Class	Date start	Time start	Date stop	Time end
0		NO	Spectral outlier detected	U	06/08/08	16:43:27	--------	--------
1		System	Systemstart	X	06/08/08	16:39:39	--------	--------
2		NO	Spectral outlier detected	U	06/08/08	16:20:07	06/08/08	16:39:38
3		NO	Spectral outlier detected	U	06/08/08	16:16:15	06/08/08	16:19:53
4		NO	Spectral outlier detected	U	06/08/08	16:15:50	06/08/08	16:16:05
5		NO	Spectral outlier detected	U	06/08/08	16:07:48	06/08/08	16:08:03
6		NO	Spectral outlier detected	U	06/08/08	16:07:33	06/08/08	16:07:38
7		NO	Spectral outlier detected	U	06/08/08	15:21:35	06/08/08	15:46:50
8		NO	Spectral outlier detected	U	06/08/08	15:21:14	06/08/08	15:21:25
9		NO	Spectral outlier detected	U	06/08/08	15:02:41	06/08/08	15:02:46
10		NO	Spectral outlier detected	U	06/08/08	15:02:31	06/08/08	15:02:36
11		NO	Spectral outlier detected	U	06/08/08	14:20:23	06/08/08	14:39:37

Messages can be exported as follows:

1 Click on EXPORT.

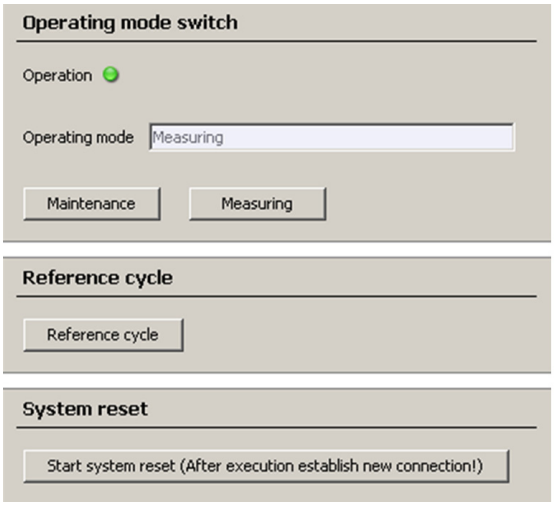
2 Select the storage location and file names.

3 Click on SAVE.

The Logbook is saved as a Log file.

Operating mode switch

Fig. 22 Operating mode switch



This screen serves to switch between Measuring mode and Maintenance mode. Apart from that, a reference cycle and a system reset can also be initiated. The parameters are not deleted. The connection between SOPAS and VICOTEC320 must be established again after a system reset (→ p. 39, § 6.3.1).

6.3.3 Saving, storing and printing the current parameter set

1 Saving the parameter set. The saved file can then be restored, for example on new hardware.
Select: EXPORT PROJECT/ DEVICE

2 Storing the project (a “project” can be several devices). This file can then, for example, be printed but can however *not* be restored in the device.

a) To store the current parameter set, select the SAVE AS command in the PROJECT menu.

b) Enter a file name in the dialog window and confirm with SAVE.
The SOPAS ET software stores the current settings in an SPR file.

3 To print the current parameter set, select the PRINT/PRINT PREVIEW command in the PROJECT menu.
The SOPAS ET software displays a preview of the tabular list of all parameter values.

4 Select the PRINT command in the FILE menu dialog window.
The PRINT dialog window opens to configure the printer.

5 Edit the settings as required and confirm with OK.
The current project settings are printed in tabular form.

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7 Scheduled Maintenance

Maintenance work

7.1 Cleaning

7.1.1 Cleaning sensors

The tube can be removed in order to clean the protective screen of the sender/receiver unit or reflector.

CAUTION: Eye damage through very bright light
UV radiation (VICOTEC322, -323, -324) and halogen light (VICOTEC321) can cause eye inflammation when eyes are subjected to the radiation for longer than 10 minutes.
► Wear protective goggles (normal glass or plastic is sufficient).

1 Loosen both nuts at the end of the tube and pull the tube off.
2 Clean the protective screens with clean optical tissues.
3 Check the tube and the optical beam path for contamination through deposits or animals and clean when necessary.
4 Position the tube and tighten both nuts.

7.2 Maintenance

7.2.1 Persons authorized to carry out maintenance

Maintenance going beyond the tasks described here must be performed by authorized technicians only and is described in the Service Manual.

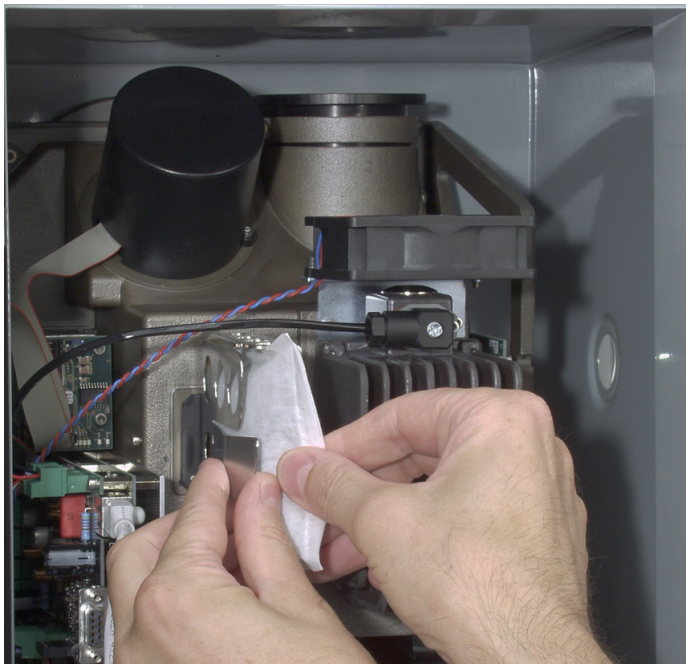
WARNING: Danger though electrical voltage.
Live parts are accessible when the device is open!
► Switch the supply voltage off before opening the device.
► Only use suitable, insulated tools.

7.2.2 Replacing the activated charcoal

The activated charcoal sachet is located in the sender/receiver unit.

► Replace the used activated charcoal sachet with a new activated charcoal sachet.

Fig. 23 Replacing the activated charcoal sachet

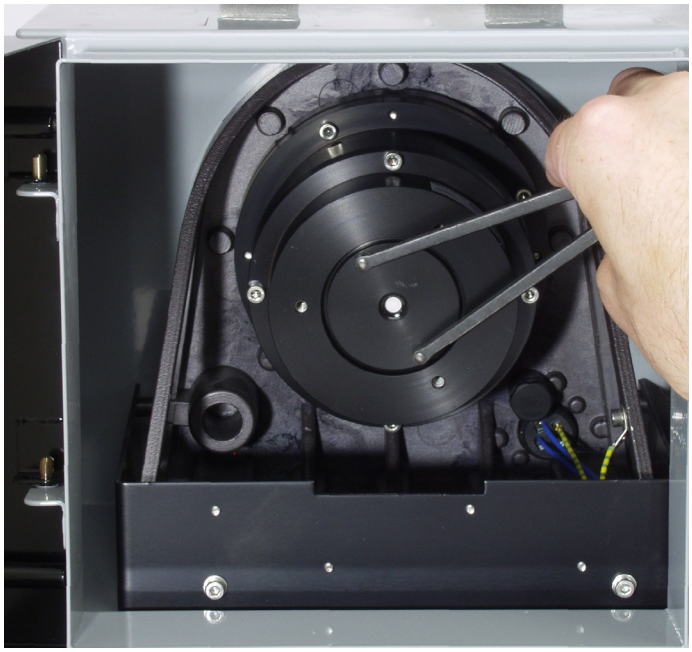


7.2.3 Replacing the drying agent cartridge

The drying agent cartridge is located in the reflector.

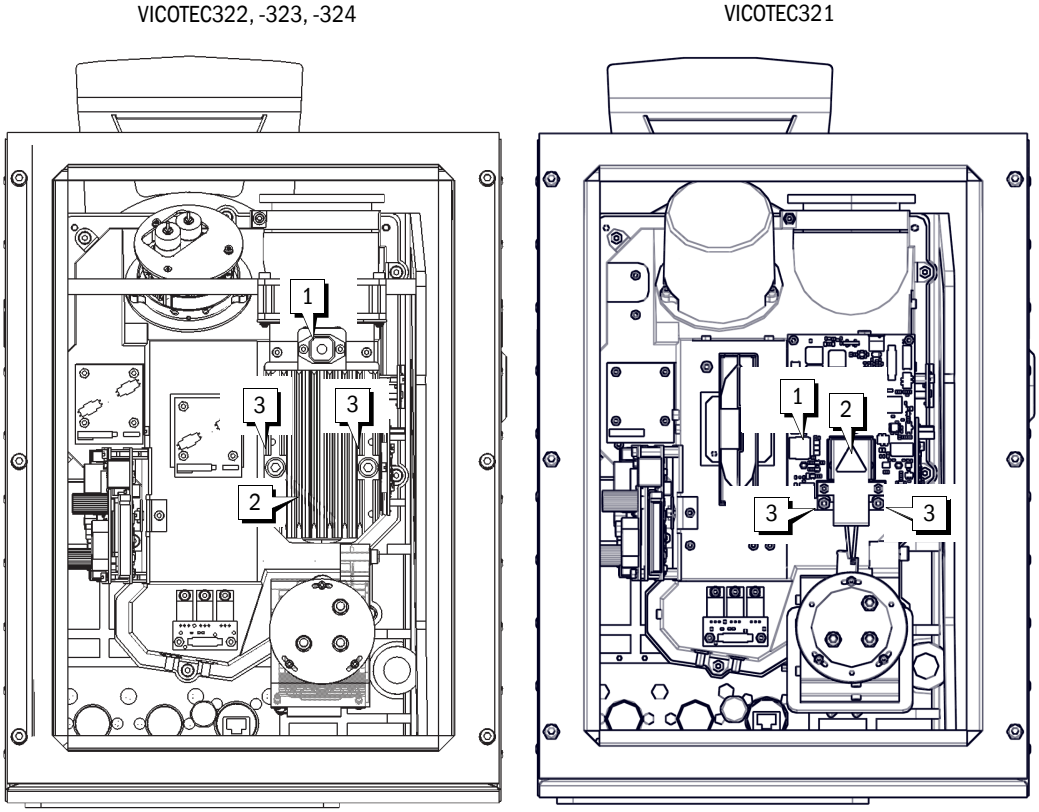
► Unscrew the lid with pin key and replace the drying agent cartridge.

Fig. 24 Replace the drying agent cartridge



7.2.4 Replacing the lamp

Fig. 25 Position of the lamp



1	Lamp plug
2	Lamp
3	Lamp retaining screws

WARNING: Lamp is hot.
Risk of skin burns
► Let the lamp cool down before exchanging it.

Exchange the lamp at regular intervals. These intervals depend on the parameter settings for the device and the ambient conditions in the tunnel and are about 1 to 4 years.

1 Disconnect all poles of the connection unit from the mains.
2 Open the enclosure cover of the sender/receiver unit.
3 Disconnect plug (1) (On VICOTEC322, -323, -324: Loosen the screw on the plug).
4 Loosen the retaining screws (3) of the lamp and take lamp (2) out.
5 Insert the new lamp and fasten with both retaining screws.
6 Connect the plug (on VICOTEC322, -323. -324: Screw the plug tight.).
7 Close the enclosure cover of the sender/receiver unit.

Measured values are output about 5 minutes after the lamp has been exchanged but can be outside the tolerances during the first 30 minutes.

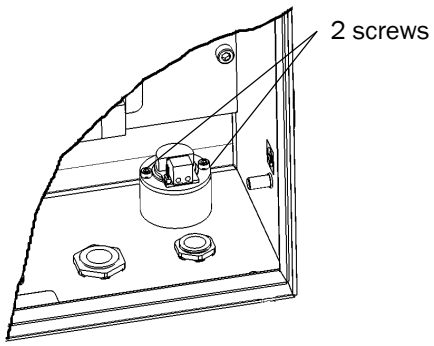
7.2.5 Replacing the CO sensor

► Replace the CO sensor once a year (recommendation).

Procedure

1 Disconnect all poles of the connection unit from the mains.
2 Disconnect both connection lines from the terminals of the small electronic board of the CO sensor.
3 Loosen 2 screws (→ Fig. 26).
4 Pull off the upper part of the CO sensor.
5 Insert the new CO sensor.
6 Screw the new CO sensor tight.
7 Reconnect both connection lines.
8 Switch the voltage supply of the connection unit on again.

Fig. 26 Position of the CO sensor in the connection unit (shown for VICOTEC322, -323, -324)



VICOTEC320

8 Troubleshooting and Fault Clearance

8.1 Fault messages

Error messages are shown in the SOPAS configuration software Logbook.

Only those error messages are shown that the user can clear in own responsibility. Please contact SICK Customer Service for all other error messages.

Source	Error message	Significance	Clearance
System	Lamp fault	Lamp does not go on.	Exchange lamp (→ p. 48, § 7.2.4).
System	Mirror adj. End	Mirror tracking has reached maximum position.	Check alignment and realign when necessary (see Service Manual).
Visibility	No signal	Sudden signal loss of more than 50% (light path interrupted).	Check for animals or dirt in the dust tubes or other obstacles in the optical beam path (→ p. 46, § 7.1.1).
System	Lamp spectro	UV lamp current for spectrometer operation exceeds 1000 mA (limit).	Exchange the UV lamp if required (→ p. 48, § 7.2.4) or correct the parameter settings (see Service Manual).
System	Lamp 4Q	UV lamp current for visibility measurement operation exceeds 1000 mA during adjustment (limit).	Exchange the UV lamp if required (→ p. 48, § 7.2.4) or correct the parameter settings (see Service Manual).
System	Temp. Extern	External temperature sensor defective.	Check connection, exchange the sensor if required (see Service Manual).
Temperature	Temp failure	Temperature sensor signal invalid.	Check connection, exchange the sensor if required (see Service Manual).
System	CO failure	The read in current of the CO sensors is below the error limit (see SOPAS ET: Factory setting 35 mA) or above 21 mA.	Check the wiring of the CO sensor. Check the settings of the analog input (in SOPAS ET). Otherwise: Replace the CO sensor (→ page 49, § 7.2.5).
System	Systemstart	Shows when the last system start was made.	-
System	Zero adjust	Shows when the last adjustment was made.	-
System	Spantest	Shows when the last spantest was made.	-

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9 Technical Documentation

Operating data

9.1 Operating data

Measured value recording	
Measured variable:	NO/NO_2/CO/visibility/temperature
Measuring range:	– NO: min. 0 ... 20 ppm, max. 0 ... 45 ppm (0 ... 25 mg/m³, 0 ... 60 mg/m³) – NO_2: min. 0 .. 1 ppm, max. 0 ... 5 ppm (0 ... 2 mg/m³, 0 ... 10 mg/m³) – CO (option): Max. 0 -- 300 ppm – Visibility: 0 ... $15*10^{-3}$ m^{-1} – Temperature: –25...+55 °C
Measuring principle:	– NO/NO_2: UV/VIS spectroscopy (DOAS principle, Differential Optical Absorption Spectroscopy) – CO: Electrochemical cell – Visibility: Transmission measurement
Measuring section:	10 or 20 m, +/- 1 %
Interval - measuring cycle:	– 5 ... 360 s (adjustable) – CO: 50 s
T90:	– 60 s
Reference cycle interval	– 2 h (Adjustable: 0 .. 1440 min)

Max. measurement error	
Temperature:	± 2 K
Visibility:	± $0.8*10^{-3}$/m
Accuracy: - NO: - NO_2 (VICOTEC321): - CO:	± 5 % of measuring range ± 1 ppm ± 0.05 ppm Approx. 10 ppm

Device features		
Measuring path length:	10 or 20 m	
Light source:	VICOTEC 321: Halogen lamp VICOTEC 322, -323, -324: UV Deuterium lamp	
Material:	Stainless steel enclosure (1.4571)	
Device dimensions: (W x H x D)	Sender/receiver unit: Reflector: Connection unit:	718 x 470 x 310 mm 617 x 278 x 245 mm 450 x 254 x 148 mm
Weights:	Sender/receiver unit: Reflector: Connection unit:	20 kg 9 kg 8 kg
Enclosure color:	Gray RAL 7042, powder-coated	
Temperature sensor:	Pt 1000	

Ambient conditions	
Ambient temperature:	–25 ... +55 °C; CO cell: –20 ... +40 °C
Storage temperature:	–25 ... +75 °C; CO cell: –40 ... +55 °C
Relative humidity:	10 ... 95 % non-condensing
Ambient air pressure:	700 ... 1200 hPa
Protection class:	IP 69K

Interfaces	
Display:	LEDs
Relay outputs:	For NO, NO_2, visibility: – Operation/Fault – Maintenance request – Function control For CO: – Operation/Fault
Digital inputs:	– Maintenance mode
Analog outputs:	– NO – NO_2 – Visibility – Temperature – CO
Ethernet:	10 BaseT
Slot:	Compact Flash Type II

Mechanical installation	
Measuring section:	10 or 20 m
Allowable fitting location[1]	Along the measuring section: 0° Transverse to measuring section: ± 15°
Electrical connection line:	→ p. 22, § 4.3

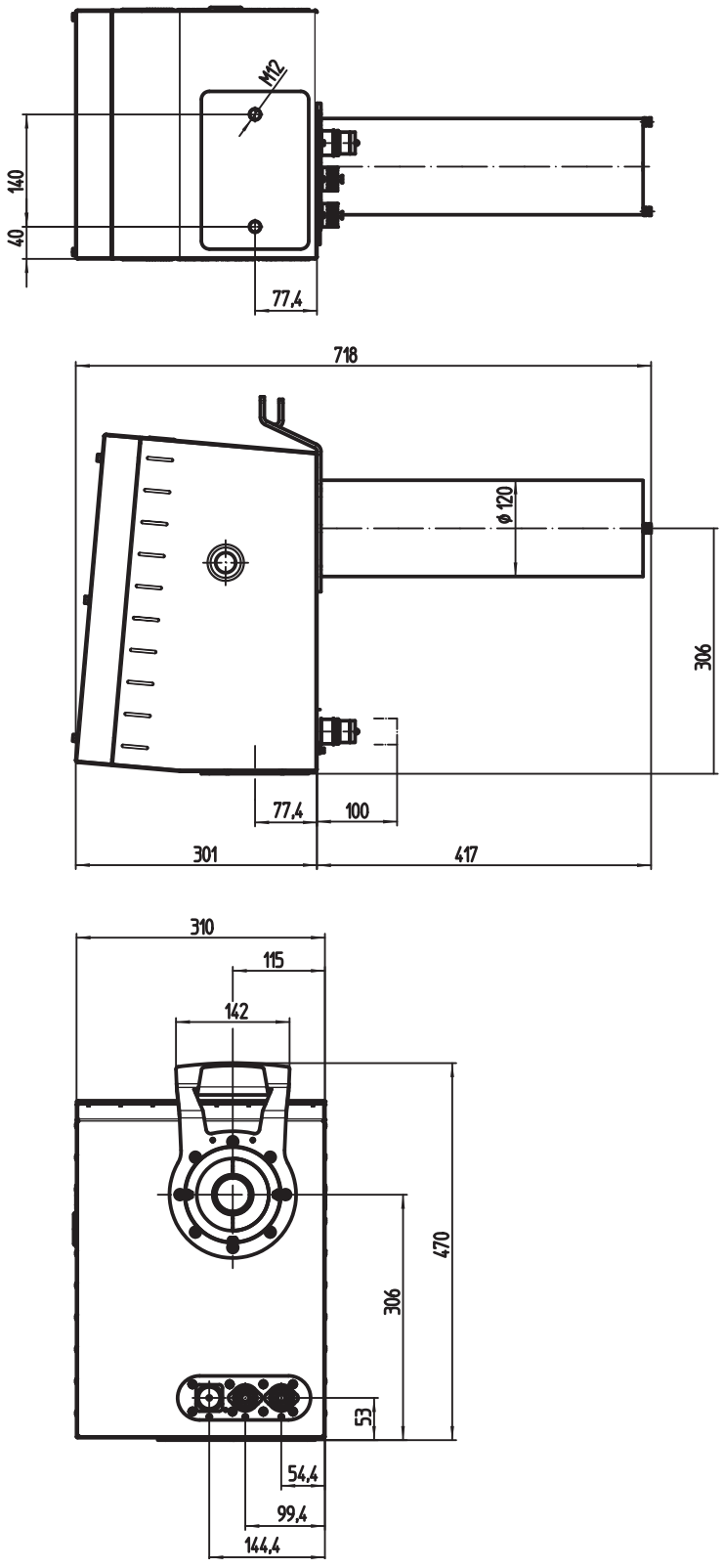
[1]Allowable enclosure tilt during operation

Electrical installation	VICOTEC322, -323, -324	VICOTEC321
Mains fuses:	115 V: 2 A, slow, 5x20 mm 230 V: 1 A, slow, 5x20 mm	3.15 A, 5x20 mm (not accessible)
Secondary fuses:	24 V DC: 6.3A, slow, 5x20mm 120V: 1.6A slow, 5 x 20 mm	24 V DC: 2 A, slow Reflector heating (→ Fig. 16)
Supply voltage:	230 V AC +6 % /–10 %; 50 Hz 115 V AC +6 % /–10 %; 60 Hz	85 - 264 VAC, 47 - 63 Hz
Power input:	200 VA	100 VA

9.2 Dimensions

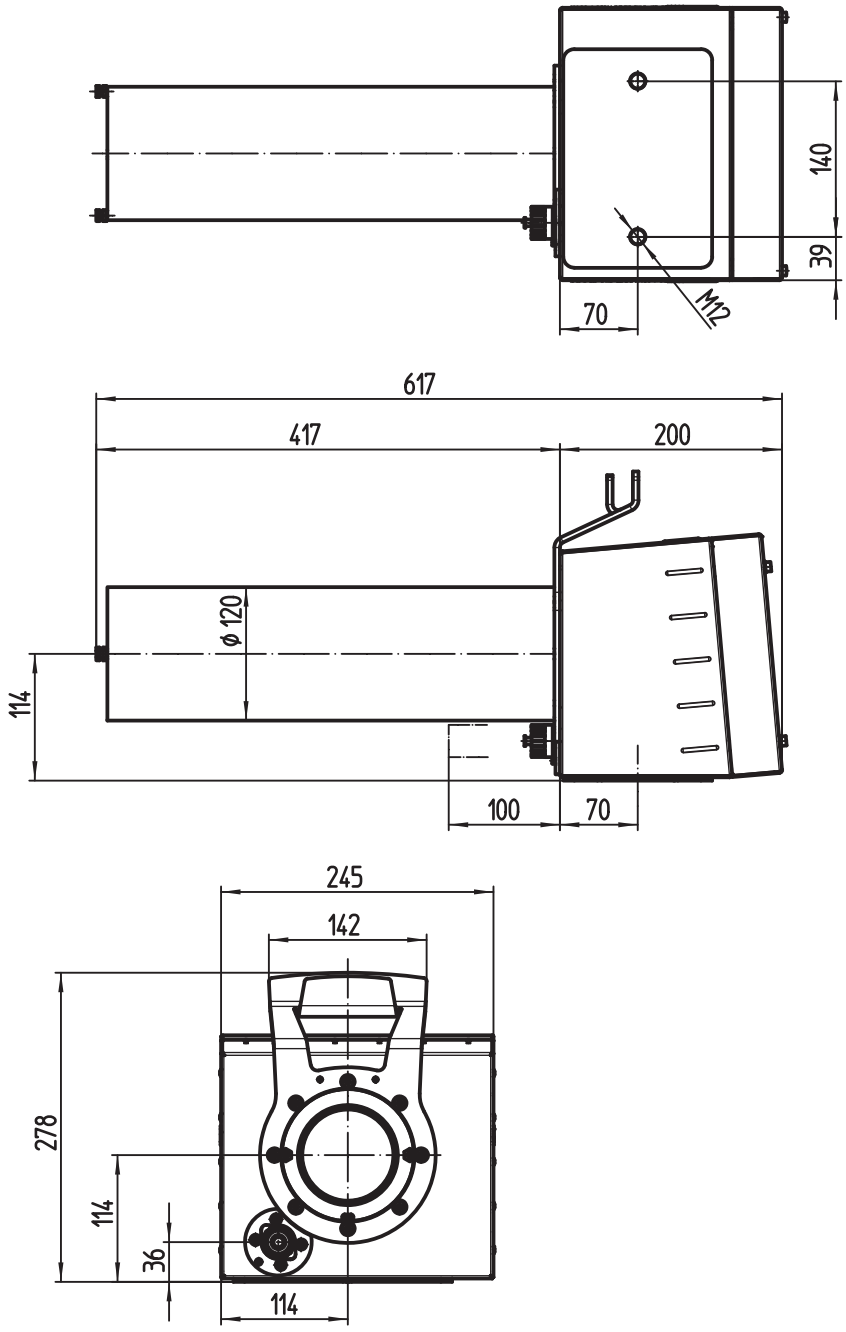
9.2.1 Sender/receiver unit

Fig. 27 Sender/receiver unit dimensions



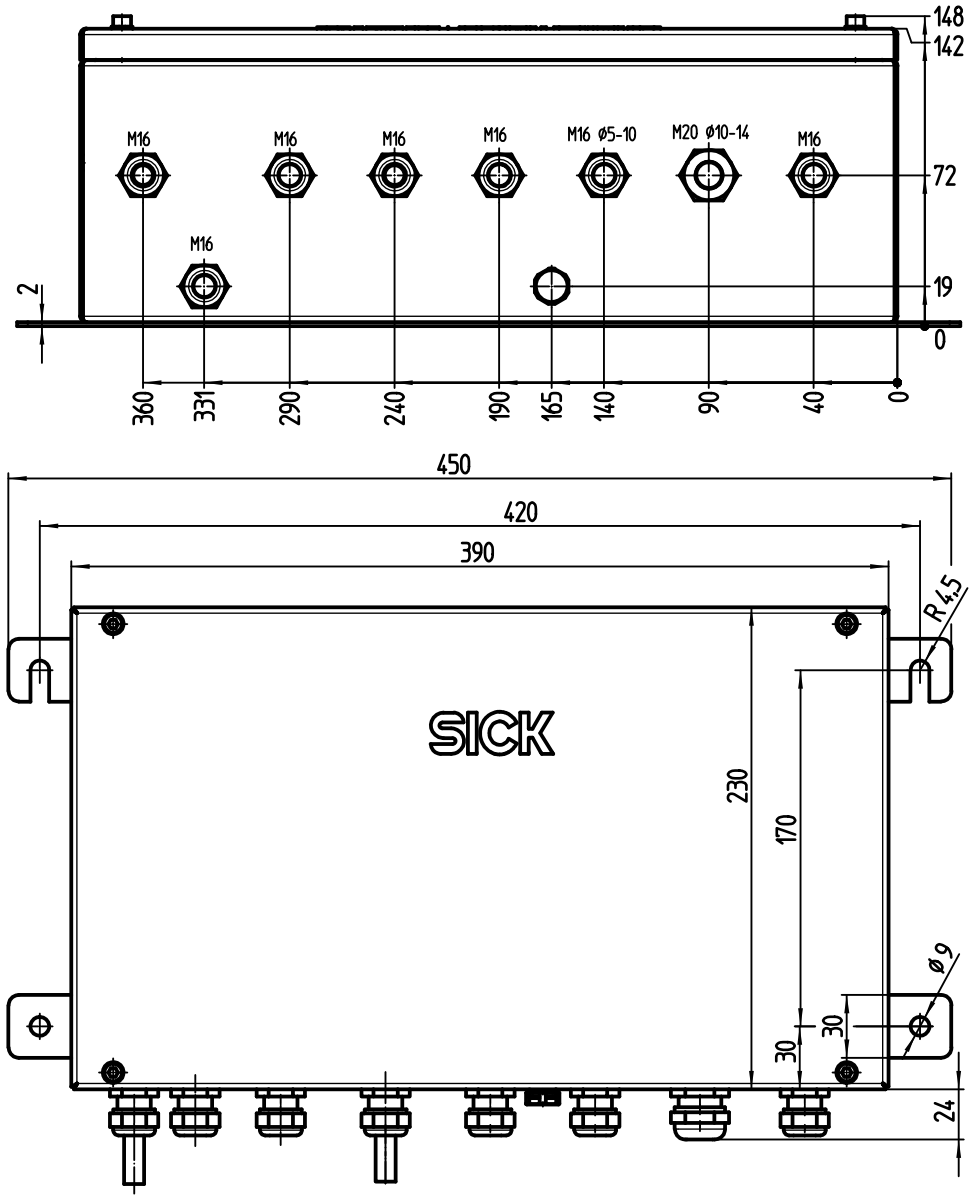
9.2.2 Reflector

Fig. 28 Reflector dimensions



9.2.3 **Connection unit**

Fig. 29 Connection unit dimensions



9.3 Part Nos.

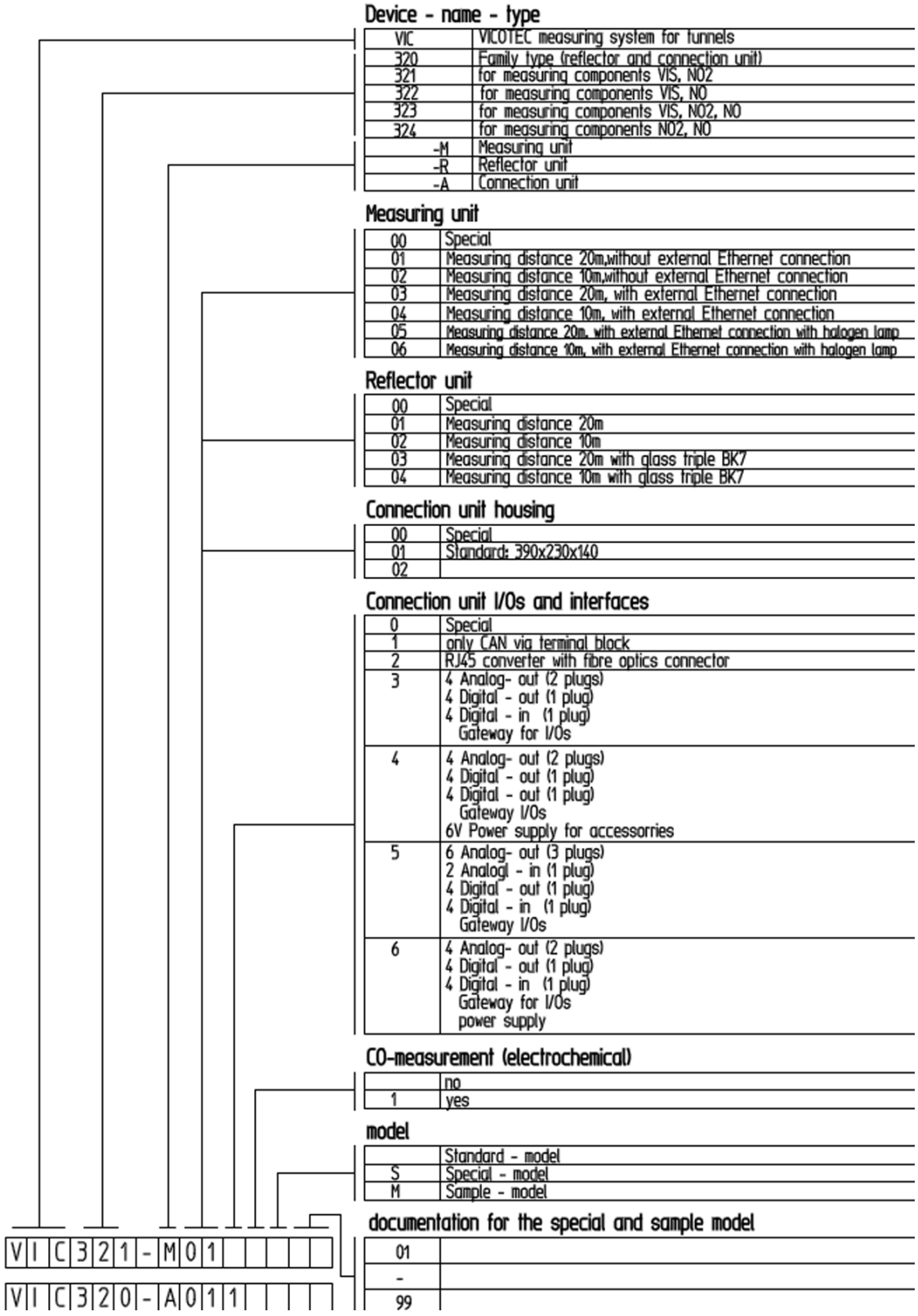
9.3.1 Device components

Part number	Designation	Type
1028793	VIC320-A011 CONNECTION UNIT	VIC320-A011
1041130	VIC320-A012 CONNECTION UNIT	VIC320-A012
1040009	VIC320-A013 CONNECTION UNIT	VIC320-A013
1041069	VIC320-A014 CONNECTION UNIT	VIC320-A014
1050553[1]	VIC320-A016 CONNECTION UNIT	VIC320-A016
1044818	VIC320-A0151 connection unit with electrochemical cell for CO	VIC320-A0151
1052357[1]	VIC320-A0161 connection unit with electrochemical cell for CO	VIC320-A0161
1028736	VIC320-R01 REFLECTOR MS=20M	VIC320-R01
1040643	VIC320-R02 REFLECTOR MS=10M	VIC320-R02
1051332[1]	VIC320-R03 REFLECTOR MS=20M	VIC320-R03
1051333[1]	VIC320-R04 REFLECTOR MS=10M	VIC320-R04
1051235	VIC321-M05 OPTIC HEAD MS=20M	VIC321-M05
1031236	VIC321-M06 OPTIC HEAD MS=10M	VIC321-M06
1041126	VIC322-M03 OPTIC HEAD MS=20M	VIC322-M03
1040642	VIC322-M04 OPTIC HEAD MS=10M	VIC322-M04
1028627	VIC323-M03 OPTIC HEAD MS=20M	VIC323-M03
1041127	VIC323-M04 OPTIC HEAD MS=10M	VIC323-M04
1041128	VIC324-M03 OPTIC HEAD MS=20M	VIC324-M03
1041129	VIC324-M04 OPTIC HEAD MS=10M	VIC324-M04

[1]Only for VICOTEC321

9.3.2 Type key

Fig. 30 Type key



9.3.3 Accessories

Part No.	Designation
2031397	Assembly console made of 1.4571 stainless steel
2034795	Laser adjustment unit (1 piece)
2040063	Filter and cuvette case for linearity test

9.3.4 Expendable and wearing parts

Part No.	Designation
2033796	UV lamp
2055423	Halogen lamp
2012785	Drying agent cartridge (reflector)
5323946	Activated charcoal sachet (sender/receiver unit)
2045856	CO sensor

VICOTEC320

10 Mapping Table

Mapping Table for SCU

10.1 Mapping Table

Mapping Table for SCU parameter settings

10.1.1 Measured values on SCU

- Measured value (MV)

Index	Measured value
MV01	VIS [1/Km]
MV02	T [K]
MV03	NO (not used on VICOTEC321)
MV04	NO2 [ppm]
MV05	CO [ppm]

10.1.2 Operating State Table

- States (S)

Index	Operating state
S01	Initialization
S02	Warming up
S03	Measuring
S04	Maintenance
S05	Maintenance Switch
S06	Zero adjust
S07	Alignment
S08	RCycle
S09	RESTART
S10	Span Test

10.1.3 Status

- Failure, Maintenance, Uncertain, Check, Extended

Index	Diagnostic message
F01..F64	Failure messages
M01..M32	Maintenance messages
U01..U08	Uncertain messages
C01..C08	Check messages
E01..E16	Extended messages

10.1.4 Status of measured values

- MVxx (xx = 01..04)

Index	Diagnostic message
MVxxF01..F64	Failure messages
MVxxE01..E32	Extended messages
MVxxU01..U16	Uncertain messages
MVxxM01..M08	Maintenance messages
MVxxC01..C08	Check messages

8011703/2013-07/2-2/ISubject to change without notice

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